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INCREASE IN THE FIDELITY OF IMAGE DURING THE PRODUCTION OF DIAP--ETC(U)
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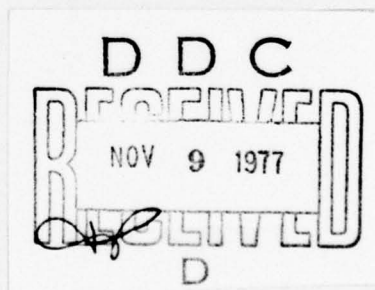
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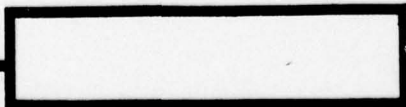
INCREASE IN THE FIDELITY OF IMAGE DURING THE
PRODUCTION OF DIAPOSITIVES

by

O. V. Portnova



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WP-AFB, OHIO.

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Block	Italic	Transliteration	Block	Italic	Transliteration
А а	А а	A, a	Р р	Р р	R, r
Б б	Б б	B, b	С с	С с	S, s
В в	В в	V, v	Т т	Т т	T, t
Г г	Г г	G, g	У у	У у	U, u
Д д	Д д	D, d	Ф ф	Ф ф	F, f
Е е	Е е	Ye, ye; E, e*	Х х	Х х	Kh, kh
Ж ж	Ж ж	Zh, zh	Ц ц	Ц ц	Ts, ts
З з	З з	Z, z	Ч ч	Ч ч	Ch, ch
И и	И и	I, i	Ш ш	Ш ш	Sh, sh
Й й	Й й	Y, y	Щ щ	Щ щ	Shch, shch
К к	К к	K, k	Ъ ъ	Ъ ъ	"
Л л	Л л	L, l	Ы ы	Ы ы	Y, y
М м	М м	M, m	Ь ь	Ь ь	'
Н н	Н н	N, n	Э э	Э э	E, e
О о	О о	O, o	Ю ю	Ю ю	Yu, yu
П п	П п	P, p	Я я	Я я	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere.
 When written as ё in Russian, transliterate as yë or ë.
 The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

GREEK ALPHABET

Alpha	A	α	α	Nu	N	ν
Beta	B	β		Xi	Ξ	ξ
Gamma	Γ	γ		Omicron	Ο	ο
Delta	Δ	δ		Pi	Π	π
Epsilon	E	ε	ε	Rho	Ρ	ρ ϑ
Zeta	Z	ζ		Sigma	Σ	σ ς
Eta	H	η		Tau	Τ	τ
Theta	Θ	θ	θ	Upsilon	Υ	υ
Iota	I	ι		Phi	Φ	φ φ
Kappa	K	κ	κ	Chi	Χ	χ
Lambda	Λ	λ		Psi	Ψ	ψ
Mu	M	μ		Omega	Ω	ω

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English
sin	sin
cos	cos
tg	tan
ctg	cot
sec	sec
cosec	csc
sh	sinh
ch	cosh
th	tanh
cth	coth
sch	sech
csch	csch
arc sin	\sin^{-1}
arc cos	\cos^{-1}
arc tg	\tan^{-1}
arc ctg	\cot^{-1}
arc sec	\sec^{-1}
arc cosec	\csc^{-1}
arc sh	\sinh^{-1}
arc ch	\cosh^{-1}
arc th	\tanh^{-1}
arc cth	\coth^{-1}
arc sch	sech^{-1}
arc csch	csch^{-1}
<hr/>	
rot	curl
lg	log

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INCREASE IN THE FIDELITY OF IMAGE DURING THE PRODUCTION OF
DIAPOSITIVES.

Chief engineer of the TsOIL O. V. Portnov

Pages 44-47.

During the execution of large-scale stereotopographic photographing especially sharply gets up the task of an improvement in the quality of the materials of aerial photography and their treatment. It is known that the distortions of image on aerial photographs appear both in the process of the photographing of locality and photographic treatment of aerial films and in the process of the production of diapositives in a contact manner.

In the practice of production works are known the cases of the appearance of considerable strains of photogrammetric grid/networks

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and local errors of the coordinates of the points, which retain the value and character during the repeated construction of grid/networks by these diapositives. The elimination of the indicated errors was achieved only during repeated photo-triangulation on the newly prepared diapositives. In connection with this they were carried out study of errors in the reconstruction of image on diapositives in a contact manner to KPU-1. ^[K П Y - 1]

The possible sources of the errors of the contact production of diapositives they are:

1) the disturbance/breakdown of the adjustment of contact machine tool (tool houses);

2) the strain of aerial film at the torque/moment of contact press as a result of the effect of the temperature, air humidity and mechanical effects on film at vacuum clamp;

3) the migration of the emulsion of photographic plates.

The errors, caused by the migration of the emulsion of glass plates, are known ¹.

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FOOTNOTE Afremov V. ^G~~A~~., Knorozov S. V., Lavrov V. N., Uspenskiy A. N., Pomin Yu. ^M~~M~~. The strains of the emulsion layer of photographic plates are ^G"geodesy and cartography", 1966, No. 11.

Therefore when conducting experimental studies was placed the task to determine the values of the distortions of image, introduced by all sources of errors. For this purpose it was manufactured in a row five diapositives from one sequence of the aerial film, obtained with the aerial camera AFA-T^ES-10, with the image of the grid of crosses. Diapositives were manufactured on photographic plates, whose deviation of the surface of emulsion layer from plane did not exceed 0.05 mm.

The development of the plates exposed was fulfilled by usual methods. On each copy of grid were monocularly measured coordinates x, y of 25 points, forming 16 squares with side 40 mm. Measurements were made with the stereocomparator SKV-1 by two methods of observations. The mean square error, calculated according to differences in the dual measurements, was ± 1.5 ⁴mm.

Diapositives they oriented along the axis Y of instrument. For the checking of the constancy of the position of diapositive on the carriage of comparator and absence of short duration failures

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measuring and the register systems of instrument, repeatedly they observed a series of the points of grid.

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The fidelity of image was estimated according to the disagreements of the coordinates of the analogous/similar points of each of the diapositives relative to one of them.

For the exception/elimination of the effect of errors in centering and orientation of diapositives on the carriage of comparator, installation of the initial reading and total change in the picture scale on diapositive copies was made conformal transformation of coordinates into system of one of the diapositives, accepted as initial (usually first). Corrections $\delta x_i'$ and $\delta y_i'$ coordinates were calculated from the formulas

$$\left. \begin{aligned} \delta x_i' &= \Delta x_0 + \Delta x_i \Delta m - \Delta y_i \Delta z; \\ \delta y_i' &= \Delta y_0 + \Delta y_i \Delta m + \Delta x_i \Delta z; \end{aligned} \right\} \quad (1)$$

where $\left. \begin{aligned} \Delta x_i &= x_i' - x_0 \\ \Delta y_i &= y_i' - y_0 \end{aligned} \right\}$ a difference in the coordinates of point and center of gravity of 0 figure to transformation;

$$x_0 = \frac{[x_i']}{n}; \quad y_0 = \frac{[y_i']}{n}.$$

The parameters of the transformation of coordinates were determined from the formulas

$$\left. \begin{aligned} \Delta x_0 &= -\frac{[\delta x_i]}{n}; \quad \Delta y_0 = -\frac{[\delta y_i]}{n}; \\ \Delta m &= -\frac{[\Delta x_i \delta x_i + \Delta y_i \delta y_i]}{[(\Delta x_i)^2 + (\Delta y_i)^2]}; \\ \Delta z &= -\frac{[\Delta x_i \delta y_i - \Delta y_i \delta x_i]}{[(\Delta x_i)^2 + (\Delta y_i)^2]}. \end{aligned} \right\} \quad (2)$$

where n - the number of points; $\left. \begin{aligned} \delta x_i &= x'_i - x_i, \\ \delta y_i &= y'_i - y_i \end{aligned} \right\}$ difference in the coordinates of analogous/similar points on this (converted) and initial diapositives.

Then were calculated disagreements δx_i and δy_i between the transformed coordinates of points and the coordinates of these points on the initial diapositive. The fidelity of image was estimated at of the mean square errors of coordinates m_x and m_y .

^RResearch of the fidelity of image employing the procedure presented was conducted repeatedly. In this article are given the results of three experiments, made under the following conditions:

I) checking contact machine tool, caused by a reduction in the accuracy/precision of triangulation in the diapositives, which are made on this machine tool;

II) the production work, which was being fulfilled in six months after the adjustment of contact machine tool;

III) experimental studies.

Table gives the distribution of the disagreements of coordinates, value of mean square errors and are maximum the disagreements of coordinates. Figure shows the histograms of disagreement δx and δy with press to KPU-1 for each of three

experiments (I, II, III).

Into I and II experiments is used on 184 points, into III - 2312 points. On I experiment are obtained $\delta_{\max} = -82 \div +70$ by μm ; $m_x = \pm 34.0 \mu\text{m}$; $m_y = \pm 29.0 \mu\text{m}$. In II to experiment $\delta_{\max} = -21 \div +30 \mu\text{m}$; $m_x = \pm 8.8 \mu\text{m}$; $m_y = \pm 9.0 \mu\text{m}$. In III to experiment $\delta_{\max} = -17 \div +20 \mu\text{m}$; $m_x = \pm 4.0 \mu\text{m}$; $m_y = \pm 4.1 \mu\text{m}$.

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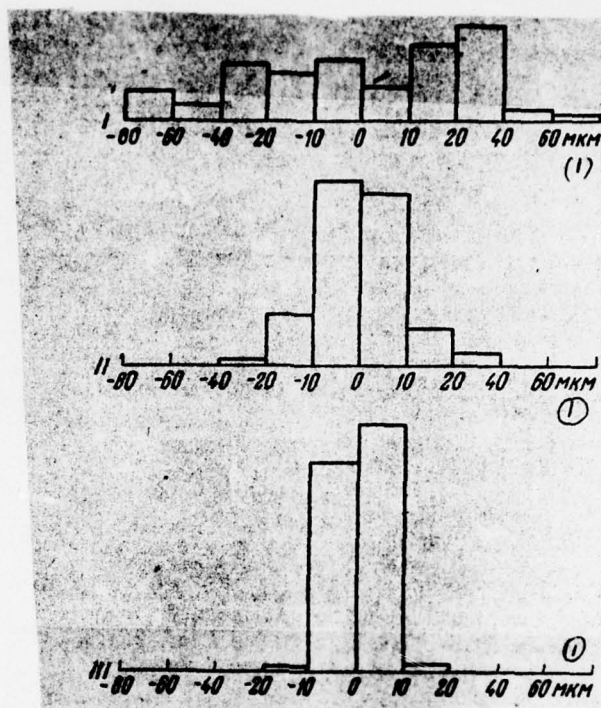
The obtained results attest to the fact that in the photogrammetric grid/networks of low quality (experiment I) the diapositives had the considerable distortions of the images, the range of which lie/rests at interval $-82 \div +70 \mu\text{m}$. Here, the number of coordinate disagreements which do not exceed $10 \mu\text{m}$, for all plates it composed a total of 21 o/o. The analysis of the disagreements of the coordinates of the points of each of the diapositives showed that the character of distortions sharply were changed from one diapositive to the next, which can be the consequence of the poor contact of unexposed aerial film with the surface of plate.

The verification/check of machine top1 determined the disturbance/breakdown of the mode/conditions of vacuum with press. The mean square errors of coordinates comprised in this case $m_x = \pm 34.0 \mu\text{m}$, $m_y = \pm 29.0 \mu\text{m}$. Immediately after the adjustment of

machine tool reproducibility of image was characterized by mean square error $\pm 6 \mu\text{m}$ during the maximum disagreement of coordinates, equal to $22 \mu\text{m}$.

In second experiment (II), in six months after the adjustment of machine tool, the mean square error of reconstruction of image was obtained equal to $\pm 9.0 \mu\text{m}$. The percentage of disagreements less than $10 \mu\text{m}$ comprised in this case 77o/o. Any disturbance/breakdowns of the adjustment of machine tool with its inspection on the completion of experiment II reveal/detected were not.

For the explanation of the possible fidelity of image on copying stand KPU-1 was made special experiment (III) immediately after the adjustment of machine tool with the careful performance of the processes of press and the observance of the conditions of development and drying of diapositives. The measurements of coordinates were made at 289 points (crosses) of diapositive, evenly arrange/located on the field of sequence. The mean square error of reconstruction of image in experiment III was obtained equal to $\pm 4 \mu\text{m}$ with the range of the disagreements of coordinates - $17\text{--}+20 \mu\text{m}$.



Key: (I) μm .

(2) Границы интервалов, мкм	(1) Распределение расхождений координат $\delta z_T, \delta y_T$ при печати на КПУ-1 в экспериментах					
	I		II		III	
	(3) число ошибок	%	(3) число ошибок	%	(3) число ошибок	%
0-5	19	10	98	53	1950	84
6-10	20	11	43	24	317	14
11-15	28	15	26	14	41	2
16-20	23	13	9	5	4	—
21-40	62	34	8	4	—	—
41-60	16	8	—	—	—	—
(4) 61-80	16	9	—	—	—	—
свыше 80	1	—	—	—	—	—

Key: (1). Distribution of the disagreements of coordinates $\delta z_T, \delta y_T$

during press to KPU-1 in experiments. (2). Boundaries of intervals, μm . (3) the number of errors. (4) it is more than.

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In this case for 2312 points (840/o) of disagreement did not exceed 5 μm , but disagreements less than 10 μm composed 980/o. The obtained results approximately two times are lower than the accuracy/precision, given in experiments in the study of the migration of emulsion layer on diapositive plates. This testifies to the effect of instrument errors and errors due to the strain of aerial film at the torque/moment of press to the value of the coordinates during copying, total quantity of which composes $m \approx \pm 6.0-9.0 \mu\text{m}$ with $m = \pm 4.0 \mu\text{m}$ on the adjusted machine tool.

Thus, the made investigations showed following.

1. The adjusted machine tool KPU-1 with the careful observance of all requirements for operation introduces the supplementary distortions of image with contact press from film and provides reconstruction of image with mean square error $\pm 4 \mu\text{m}$.

2. With the press of diapositives under production conditions the fidelity was obtained two times lower that it is explained

apparently, by the insufficient observance of vacuum conditions with press and by the instrument errors, which grew for the operating time of machine tool during six months.

3. During the operation of KPU-1 occur the cases of the disturbance/breakdown of its adjustments, which lead to a sharp incidence/drop in the fidelity of image. For the purpose of the prevention/warning of the possible errors due to the disturbance/breakdowns of the adjustment of machine tool it is necessary periodically, not less than 2-3 times per annum, to carry out its testing by the production of 4-5 spears from one negative and by the comparison of the coordinates of the analogous/similar points, evenly arrange/located on the field of photograph.

As the initial negative it is expedient to utilize sequence of film on the unexposed aerial film, used during the execution of production aerial survey works. Image on this sequence must contain the dash cell/elements (grid of the crosses of pressing glass of APA-T^EJS-10, the intersection of the primes of grid, imprinted in film, and, etc), which ensure the reliable determination of their coordinates during observations.

For an increase in the reliability of the results of testing the number of control points it is expedient to increase to 81 (side of FTD-ID(RS)T-0325-77

square 20 mm). In enterprise is comprised the program for EVM [IBM -
- computer], which accelerates and which simplifies processing the
results of measurements.

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